

## Subpart C—Emission Regulations for 1994 and Later Model Year Gasoline-Fueled New Light-Duty Vehicles and New Light-Duty Trucks; Cold Temperature Test Procedures

SOURCE: 57 FR 31916, July 17, 1992, unless otherwise noted.

### §86.201–94 General applicability.

(a) This subpart describes procedures for determining the cold temperature carbon monoxide (CO) emission from 1994 and later model year new gasoline-fueled light-duty vehicles and light-duty trucks.

(b) All of the provisions of this subpart are applicable to testing conducted at a nominal temperature of 20 °F (–7 °C).

(c) The provisions that are specially applicable to testing at temperatures between 25 °F (–4 °C) and 68 °F (20 °C) are specified in § 86.246–94 of this subpart.

### §86.202–94 Definitions.

The definitions in subpart A of this part apply to this subpart.

### §86.203–94 Abbreviations.

The abbreviations in subpart A of this part apply to this subpart.

### §86.204–94 Section numbering; construction.

(a) In the section number, the two digits following the hyphen designate the first model year for which a section is effective. A section remains effective until superseded.

(b) *Example.* Section 86.204–94 applies to the 1994 and subsequent model years until superseded. If a § 86.204–96 is promulgated it would take effect beginning with the 1996 model year; § 86.204–94 would apply to model years 1994 through 1995.

### §86.205–94 Introduction; structure of this subpart.

(a) This subpart describes the equipment required and the procedures to follow in order to perform gaseous exhaust emission tests on gasoline-fueled light-duty vehicles and light-duty trucks. Subpart A of this part sets forth testing requirements and test intervals necessary to comply with EPA certification procedures.

(b) A section reference without a model year suffix refers to the section applicable for the appropriate model years.

(c) Three topics are addressed in this subpart. Sections 86.206 through 86.215 set forth specifications and equipment requirements; §§ 86.216 through 86.226 discuss calibration methods and frequency; test procedures and data requirements are listed (in approximate order of performance) in §§ 86.227 through 86.245.

### §86.206–94 Equipment required; overview.

This subpart contains procedures for exhaust emission tests on gasoline-fueled light-duty vehicles and light-duty trucks. Equipment required and specifications are as follows:

(a) *Exhaust emission tests.* Exhaust from gasoline-fueled vehicles is tested for gaseous emissions using the Constant Volume Sampler (CVS) concept (§ 86.209). Equipment necessary and specifications appear in §§ 86.208 through 86.214.

(b) *Fuel, analytical gas, and driving schedule specifications.* Fuel specifications for exhaust emission testing for gasoline-fueled vehicles are specified in § 86.213. Analytical gases are specified in § 86.214. The EPA Urban Dynamometer Driving Schedule (UDDS) for use in gasoline-fueled emission tests is specified in § 86.215 and appendix I to this part.

### §86.207–94 [Reserved]

### §86.208–94 Dynamometer.

(a) For testing that is conducted by the Administrator, the dynamometer shall have a single roll with a nominal diameter of 48 inches (1.22 meters), an electrical power absorption unit for simulation of road load power, flywheels or other means for simulating the inertia weight as specified in § 86.229, and a roll or shaft revolution counter or other means for determining distance driven.

(b) For certification testing that is conducted by the manufacturer, a dynamometer with different characteristics may be used provided cold CO emissions are not decreased.

### §86.209–94 Exhaust gas sampling system; gasoline-fueled vehicles.

The provisions of § 86.109–90 apply to this subpart.

### §86.210–94 [Reserved]

### §86.211–94 Exhaust gas analytical system.

The provisions of § 86.111 apply to this subpart, except that the NO<sub>x</sub> analyzer is optional.

## § 86.213–94

### § 86.212–94 [Reserved]

### § 86.213–94 Fuel specifications.

Gasoline having the following specifications will be used by the Administrator. Gasoline having the specifications set forth in the table in this section, or substantially equivalent specifications approved by the Administrator, may be used by the manufacturer except that the octane specification

does not apply. In lieu of using gasoline having these specifications, the manufacturer may, for certification testing, use gasoline having the specifications specified in § 86.113–90 provided the cold CO emissions are not decreased. Documentation showing that cold CO emissions are not decreased shall be maintained by the manufacturer and shall be made available to the Administrator upon request.

TABLE.—COLD CO FUEL SPECIFICATIONS

Item	ASTM test	Cold CO low octane value or range	Cold CO high octane <sup>1</sup> value or range
(RON+MON)/2, min .....	D2699	87.8±.3	92.3±0.5
Sensitivity, min .....	D2699	7.5	7.5
Distillation range:			
IBP, °F .....	D86	76–96	76–96
10% point, °F .....	D86	98–118	105–125
50% point, °F .....	D86	179–214	195–225
90% point, °F .....	D86	316–346	316–346
EP, max, °F .....	D86	413	413
Sulfur, wt. % .....	D3120	0.035±0.015	0.020±0.015
Phosphorous, g/U.S gal, max .....	D3231	0.005	0.005
Lead, g/gal, max .....		0.01	0.01
RVP, psi .....	D4953	11.5±.3	11.5±.3
Hydrocarbon composition .....	D1319		
Olefins, vol. pct .....		12.5±5.0	10.0±5.0
Aromatics, vol. pct .....		26.4±4.0	32.0±4.0
Saturates .....		Remainder	Remainder

<sup>1</sup> Gasoline having these specifications may be used for vehicles which are designed for the use of high-octane premium fuel.

### § 86.214–94 Analytical gases.

The provisions of § 86.114–94 apply to this subpart.

### § 86.215–94 EPA urban dynamometer driving schedule.

The provisions of § 86.115–78 apply to this subpart.

### § 86.216–94 Calibrations, frequency and overview.

The provisions of § 86.116–94 apply to this subpart.

### § 86.217–94 [Reserved]

### § 86.218–94 Dynamometer calibration.

The provisions of § 86.118–78 apply to this subpart.

### § 86.219–94 CVS calibration.

The provisions of § 86.119–90 apply to this subpart.

### § 86.220–94 [Reserved]

### § 86.221–94 Hydrocarbon analyzer calibration.

The provisions of § 86.121–90 apply to this subpart.

### § 86.222–94 Carbon monoxide analyzer calibration.

The provisions of § 86.122–78 apply to this subpart.

### § 86.223–94 Oxides of nitrogen analyzer calibration.

The provisions of § 86.123–78 apply to this subpart if NO<sub>x</sub> measurements are optionally made.

### § 86.224–94 Carbon dioxide analyzer calibration.

The provisions of § 86.124–78 apply to this subpart.

### § 86.225–94 [Reserved]

### § 86.226–94 Calibration of other equipment.

The provisions of § 86.126 apply to this subpart.

## § 86.230–94

### § 86.227–94 Test procedures; overview.

The provisions of § 86.127–94 (a), (b), and (e) apply to this subpart.

### § 86.228–94 Transmissions.

The provisions of § 86.128–79 apply to this subpart.

### § 86.229–94 Road load force, test weight, and inertia weight class determination.

(a) Flywheels, electrical forces, or other means of simulating test weight as shown in the table in this paragraph shall be used. If the equivalent test weight specified is not available on the dynamometer being used, the next higher equivalent test weight (not to exceed 250 pounds) available shall be used. Light-duty vehicles over 5750 lbs. loaded vehicle weight shall be tested at a 5,500 lb. equivalent test weight.

Loaded vehicle weight (pounds)	Equivalent test weight (pounds)	Inertia weight class (pounds)
Up–1,062 .....	1,000	1,000
1,063–1,187 .....	1,125	1,000
1,188–1,312 .....	1,250	1,250
1,313–1,437 .....	1,375	1,250
1,438–1,562 .....	1,500	1,500
1,563–1,687 .....	1,625	1,500
1,688–1,812 .....	1,750	1,750
1,813–1,937 .....	1,875	1,750
1,938–2,062 .....	2,000	2,000
2,063–2,187 .....	2,125	2,000
2,188–2,312 .....	2,250	2,250
2,313–2,437 .....	2,375	2,250
2,438–2,562 .....	2,500	2,500
2,563–2,687 .....	2,625	2,500
2,688–2,812 .....	2,750	2,750
2,813–2,937 .....	2,875	2,750
2,938–3,062 .....	3,000	3,000

Loaded vehicle weight (pounds)	Equivalent test weight (pounds)	Inertia weight class (pounds)
3,063–3,187 .....	3,125	3,000
3,188–3,312 .....	3,250	3,000
3,313–3,437 .....	3,375	3,500
3,438–3,562 .....	3,500	3,500
3,563–3,687 .....	3,625	3,500
3,688–3,812 .....	3,750	3,500
3,813–3,937 .....	3,875	4,000
3,938–4,125 .....	4,000	4,000
4,126–4,375 .....	4,250	4,000
4,376–4,625 .....	4,500	4,500
4,626–4,875 .....	4,750	4,500
4,876–5,125 .....	5,000	5,000
5,126–5,375 .....	5,250	5,000
5,376–5,750 .....	5,500	5,500
5,751–6,250 .....	6,000	6,000
6,251–6,750 .....	6,500	6,500
6,751–7,250 .....	7,000	7,000
7,251–7,750 .....	7,500	7,500
7,751–8,250 .....	8,000	8,000
8,251–8,750 .....	8,500	8,500
8,751–9,250 .....	9,000	9,000
9,251–9,750 .....	9,500	9,500
9,751–10,000 .....	10,000	10,000

(b) A dynamometer which meets the specifications of § 86.208–94(a) shall be adjusted to simulate the operation of a vehicle on the road at 20 °F (–7 °C). Such adjustment may be based on a determination of the road load force profile at 20 °F (–7 °C). Alternatively, the adjustment may be based on a 10 percent decrease in the target coastdown time that is used for FTP testing.

### § 86.230–94 Test sequence; general requirements.

(a) *Sequence steps.* Figure C94–1 shows the steps encountered as the test vehicle undergoes the procedures subsequently described, to determine conformity with the standards set forth.

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(b) *Driving schedule.* The Urban Dynamometer Driving Schedule (UDDS) test procedure (see § 86.115 and Appendix I to this part) is used for vehicle preconditioning and testing.

(c) *Ambient temperature level.* (1) Ambient temperature levels encountered by the test vehicle shall average  $20^{\circ}\text{F} \pm 5^{\circ}\text{F}$  ( $-7^{\circ}\text{C} \pm 2.8^{\circ}\text{C}$ ) and shall not be less than  $10^{\circ}\text{F}$  ( $-14^{\circ}\text{C}$ ) nor more than  $30^{\circ}\text{F}$  ( $-1^{\circ}\text{C}$ ) during vehicle preconditioning, except for preconditioning performed in accordance with § 86.232(a)(7), and during all emission testing.

(2) The ambient temperature reported shall be a simple average of the test cell temperatures measured at constant intervals no more than one minute apart. Before the driving cycle may begin, the test cell temperature shall be  $20^{\circ}\text{F} \pm 3^{\circ}\text{F}$  ( $-7^{\circ}\text{C} \pm 1.7^{\circ}\text{C}$ ) when measured in accordance with paragraph (e)(2) of this section. The temperature may not exceed  $25^{\circ}\text{F}$  ( $-4^{\circ}\text{C}$ ) or fall below  $15^{\circ}\text{F}$  ( $-9^{\circ}\text{C}$ ) for more than three consecutive minutes during the test.

(d) *Vehicle positioning.* The vehicle shall be approximately level during all phases of the test sequence to prevent abnormal fuel distribution.

(e) *Engine compartment cooling.* (1) Fixed speed air cooling of the engine compartment with the compartment cover open shall be utilized during testing that is conducted by the Administrator and, optionally for certification testing, by the manufacturer. If a separate movable fan is used, it shall be squarely positioned within 12 inches (30.5 centimeters) of the front of vehicles with front engine compartments. In the case of vehicles with rear engine compartments (or if special designs make the normal front engine positioning impractical), the cooling fan shall be placed in a position to provide sufficient air to maintain vehicle cooling. The fan capacity shall normally not exceed 5,300 cfm (2.50 cubic meters per second). If, however, the manufacturer showed (as provided in § 86.135–94(b)) that additional cooling is necessary, the fan capacity may be increased or additional fans used if approved in advance by the Administrator. The cooling air temperature shall be measured at the inlet to the fan.

(2) In lieu of using a separate fan, an air handling system that is integral with the test cell may be used provided comparable air movement is obtained. The cooling air temperature shall be measured in the center of a vertical plane that is located approximately 2 feet in front of the vehicle.

(3) The manufacturer may use, for certification testing, alternative engine compartment cooling fans or systems, including those which provide a variable air flow, if the manufacturer has determined that comparable results are obtained.

(f) *Heater and defroster usage.* The heater and defroster may be used at any temperature and fan settings.

### § 86.231–94 Vehicle preparation.

The provisions of § 86.131–90 apply to this subpart.

### § 86.232–94 Vehicle preconditioning.

(a) The vehicle shall be moved to the test area and the following operations performed:

(1) The fuel tank(s) shall be filled to approximately the prescribed “tank fuel volume” with the test fuel specified § 86.213. If the existing fuel in the fuel tank(s) does not meet the specifications contained in § 86.213, the existing fuel must be drained prior to the fuel fill. The test fuel shall be at a temperature less than or equal to  $60^{\circ}\text{F}$ . For the operations in this paragraph (a)(1), the evaporative emission control system shall neither be abnormally purged nor abnormally loaded.

(2) For operation on a 48-inch (1.22 metre) diameter single roll dynamometer, the drive wheel tires shall be inflated to the pressure recommended by the tire manufacturer. For operation on a twin-roll dynamometer, the drive wheel tires may be inflated to a gauge pressure of 40 psi (276 kPa). The drive wheel tire pressures shall be reported with the test results.

(3) The fuel in the vehicle shall be stabilized at  $20^{\circ}\text{F} \pm 10^{\circ}\text{F}$  ( $-7^{\circ}\text{C} \pm 5.6^{\circ}\text{C}$ ) prior to the start of the driving cycle except when vehicle preconditioning is performed in accordance with paragraph (a)(7) of this section.

(4) The vehicle shall be placed, either by being driven or pushed, on a dynamometer and operated through one UDDS cycle.

(5) For those unusual circumstances where additional preconditioning is desired by the manufacturer, such preconditioning may be allowed with the advance approval of the Administrator.

(6) The Administrator may also choose to conduct additional preconditioning. The additional preconditioning shall consist of one or more driving cycles of the UDDS, as described in paragraph (a)(4) of this section.

(7) The manufacturer may, for certification testing, precondition vehicles at temperatures above  $20^{\circ}\text{F}$  ( $-7^{\circ}\text{C}$ ) and with temperature tolerances greater than those specified in § 86.230(a) if the manufacturer has determined that such preconditioning does not decrease CO emissions during the testing specified in § 86.237.

(b) Within five minutes of completion of preconditioning, the vehicle shall be shut off. During this five minute period, the vehicle shall not experience ambient temperatures less than  $10^{\circ}\text{F}$  ( $-12^{\circ}\text{C}$ ) nor more than  $30^{\circ}\text{F}$  ( $-1^{\circ}\text{C}$ ).

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(c) One of the following two methods shall be utilized to stabilize the vehicle before the emissions test:

(1) *Storing at cold temperatures.* The vehicle shall be stored for not less than 12 hours nor for more than 36 hours prior to the cold start exhaust test. The ambient temperature (dry bulb) during this period shall be maintained at an average temperature of  $20^{\circ}\text{F} \pm 5^{\circ}\text{F}$  ( $.7^{\circ}\text{C} \pm 2.8^{\circ}\text{C}$ ) during each hour of this period and shall not be less than  $10^{\circ}\text{F}$  ( $.12^{\circ}\text{C}$ ) nor more than  $30^{\circ}\text{F}$  ( $.1^{\circ}\text{C}$ ). The ambient temperature reported shall be a simple average of the test cell temperature measured at constant intervals no more than one minute apart. In addition, the temperature may not exceed  $25^{\circ}\text{F}$  ( $.4^{\circ}\text{C}$ ) or fall below  $15^{\circ}\text{F}$  ( $.9^{\circ}\text{C}$ ) for more than three consecutive minutes.

(2) *Force-cooling or warming.* (i) The vehicle shall be stored for no more than 36 hours prior to cooling or warming for the cold start exhaust test. The vehicle shall not be stored at ambient temperatures which exceed  $86^{\circ}\text{F}$  ( $30^{\circ}\text{C}$ ) during this period.

(ii) Vehicle cooling may be accomplished by either force-cooling or force-warming the vehicle to the test temperature. If cooling is augmented by fans, the fans shall be placed in a vertical position for maximum drive train and engine cooling, not primarily oil pan cooling. Fans shall not be placed under the vehicle.

(iii) The ambient temperature need only be stringently controlled after the vehicle has been cooled to  $20^{\circ}\text{F} \pm 3^{\circ}\text{F}$  ( $.7^{\circ}\text{C} \pm 1.7^{\circ}\text{C}$ ), as determined by a representative bulk oil temperature. A representative bulk oil temperature is the temperature of the oil measured near the middle of the oil, not at the surface or at the bottom of the oil pan. If two or more diverse locations in the oil are monitored, they must all meet the temperature requirements.

(iv) The vehicle must be stored for at least one hour after it has been cooled to  $20^{\circ}\text{F} \pm 3^{\circ}\text{F}$  ( $.7^{\circ}\text{C} \pm 1.7^{\circ}\text{C}$ ) prior to the cold start exhaust test. The ambient temperature (dry bulb) during this period shall average  $20^{\circ}\text{F} \pm 5^{\circ}\text{F}$  ( $.7^{\circ}\text{C} \pm 2.8^{\circ}\text{C}$ ) and shall not be less than  $10^{\circ}\text{F}$  ( $.12^{\circ}\text{C}$ ) nor more than  $30^{\circ}\text{F}$  ( $.1^{\circ}\text{C}$ ). In addition, the temperature may not exceed  $25^{\circ}\text{F}$  ( $.4^{\circ}\text{C}$ ) or fall below  $15^{\circ}\text{F}$  ( $.9^{\circ}\text{C}$ ) for more than three consecutive minutes.

(d) If the vehicle is stabilized at  $20^{\circ}\text{F}$  ( $.7^{\circ}\text{C}$ ) in a separate area and is moved through a warm area to the test cell, the vehicle must be restabilized in the test cell for at least six times the period the vehicle is exposed to warmer temperatures. The ambient temperature (dry bulb) during this period shall average  $20^{\circ}\text{F} \pm 5^{\circ}\text{F}$  ( $.7^{\circ}\text{C} \pm 2.8^{\circ}\text{C}$ ) and shall not be less than  $10^{\circ}\text{F}$  ( $.12^{\circ}\text{C}$ ) nor more than  $30^{\circ}\text{F}$  ( $.1^{\circ}\text{C}$ ). In addition,

the temperature may not exceed  $25^{\circ}\text{F}$  ( $.4^{\circ}\text{C}$ ) or fall below  $15^{\circ}\text{F}$  ( $.9^{\circ}\text{C}$ ) for more than three consecutive minutes. The maximum time for moving a vehicle through a warm area shall be 10 minutes.

### § 86.233-94 [Reserved]

### § 86.234-94 [Reserved]

### § 86.235-94 Dynamometer procedure.

(a) *Overview.* The emission sampling is completed over two test sequences, a "cold" start test after a minimum 12-hour and a maximum 36-hour soak according to the provisions of § 86.232 and a "hot" start test following the "cold" start test by 10 minutes. Engine startup, operation over the UDDS, and engine shut-down make a complete cold start test. Engine startup and operation over the first 505 seconds of the driving schedule complete the hot start test. The exhaust emissions are diluted with ambient air and a continuously proportional sample is collected for analysis during each phase. The composite samples collected in bags are analyzed for hydrocarbons, carbon monoxide, carbon dioxide, and, optionally, other pollutants. A parallel sample of the dilution air is similarly analyzed for carbon monoxide and, optionally, hydrocarbons, carbon dioxide, and oxides of nitrogen.

(b) As long as an emission sample is not taken, practice runs over the prescribed driving schedule may be performed at test point for the purpose of finding the minimum throttle action to maintain the proper speed-time relationship or to permit sampling system adjustment.

(c) Humidity should be set low enough to prevent condensation on the dynamometer rolls.

(d) The dynamometer shall be warmed as recommended by the dynamometer manufacturer and using procedures or control methods that assure stability of the residual frictional horsepower.

(e) The time between dynamometer warming and the start of the emission test shall be no longer than 10 minutes if the dynamometer bearings are not independently heated. If the dynamometer bearings are independently heated, the emission test shall begin no longer than 20 minutes after dynamometer warming.

(f) If the dynamometer horsepower must be adjusted manually, it shall be set within one hour prior to the exhaust emission test phase. The test vehicle shall not be used to make the adjustment. Dynamometers using automatic control of preselectable power settings may be set anytime prior to the beginning of the emission test.

(g) The driving distance, as measured by counting the number of dynamometer roll or shaft revolutions, shall be determined for the transient cold

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start, stabilized cold start, and transient hot start phases of the test.

(h) Four-wheel drive vehicles will be tested in a two-wheel drive mode of operation. Full-time four-wheel drive vehicles will have one set of drive wheels temporarily disengaged by the vehicle manufacturer. Four-wheel drive vehicles which can be manually shifted to a two-wheel drive mode will be tested in the normal on-highway two-wheel drive mode of operation.

### **§ 86.236–94 Engine starting and re-starting.**

The provisions of § 86.136 apply to this subpart.

### **§ 86.237–94 Dynamometer test run, gaseous emissions.**

(a) The complete dynamometer test consists of a cold start drive of approximately 7.5 miles (12.1 kilometers) and a hot start drive of approximately 3.6 miles (5.8 kilometers).

(b) If the preconditioned vehicle is not already on the dynamometer, it shall be pushed into position.

(c) The vehicle is allowed to stand on the dynamometer during the ten minute time period between the cold and hot start test. The cold start test is divided into two periods. The first period, representing the cold start “transient” phase, terminates at the end of the deceleration which is scheduled to occur at 505 seconds of the driving schedule. The second period, representing the “stabilized” phase, consists of the remainder of the driving schedule, including engine shutdown. The hot start test is identical to the first part or transient phase of the cold start test. Therefore, the hot start test terminates after the first period (505 seconds) is run.

(d) The provisions of § 86.137(b) apply to this subpart.

### **§ 86.238–94 [Reserved]**

### **§ 86.239–94 [Reserved]**

### **§ 86.240–94 Exhaust sample analysis.**

The provisions of § 86.140 apply to this subpart.

### **§ 86.241–94 [Reserved]**

### **§ 86.242–94 Records required.**

The provisions of § 86.142–90 apply to this subpart.

### **§ 86.243–94 [Reserved]**

### **§ 86.244–94 Calculations; exhaust emissions.**

The provisions of § 86.144–94 apply to this subpart, except that NO<sub>x</sub> measurements are optional. Should NO<sub>x</sub> measurements be calculated, note that the humidity correction factor is not valid at colder temperatures.

### **§ 86.245–94 [Reserved]**

### **§ 86.246–94 Intermediate temperature testing.**

(a) This section is applicable to tests which are conducted at an intermediate temperature as defined in § 86.094–2.

(b) For testing during ambient temperatures of less than 50 °F (10 °C), the test procedure is identical to the test procedure that is used for testing at 20 °F (–7 °C) contained in 40 CFR part 86, subpart C.

(c) For testing at temperatures of 50 °F (10 °C) or higher, the FTP shall be used.